SEVENTH ANNUAL REPORT OF THE AGRICULTURAL CHEMIST FOR THE YEAR 1905-06.

PART I.

1. The work of this Department may, roughly speaking, be divided at presen into four sub-heads. These are (I) General analytical work in the Laboratory, suc as the analyses of fertilizers, famine foods, etc. (II) Investigation into Agricultura problems, such as the work in the Pot-culture house, testing the availability, applica tion and relative merits of fertilizers; percolation of solutions of fertilizers throug soils with a view of studying the extent to which they are retained and their effect o the mechanical condition of soils. (III) Plot experiments at the Experimental Far and in the Laboratory compound for determining the effect of different methods cultivation on the amount of crop reaped; testing and applying to general practic the results obtained in the Pot-culture house; testing, modifying or improvin labour-saving or other agricultural machinery and implements. (IV) Distribution o available and reliable information on all agricultural matters. To these will be added when Mr. Coleman arrives, the investigation into plant diseases and insect pests an instructions for combating them as far as possible.

2. *I. General analytical work.*—This has been divided as heretofore into tw distinct heads—(*a*) Mineral and rock analyses, assaying and gold analyses for th Geological Department and (*b*) the analyses of fertilizers, foods, soils, etc., which appeared desirable to analyse in the interest of agricultural work :—

(*a*) The two Senior Assistants have been exclusively engaged on the Geolog cal work. They have analysed 21 rocks and minerals, 22 samples of gold a made 85 assays. This work is entirely for the Geological Department and is reporte on, so far as it is reported on at all, by the Geological Department.

(*b*) For the agricultural work of the Laboratory there has been, up to th beginning of the year under review, only one Assistant. This has handicapped th work very much in the past. At the beginning of the year two other Assistan were appointed. But these are young graduates who have as yet little experien analytical work. Their knowledge of Chemistry consisted when appointed in what required for the Physics course of the University of Madras and of what they learne in a year's training in this Laboratory. They are, however, doing useful work no and will, it is hoped, improve materially with time. Two other students are no being trained in Analytical Chemistry in the Laboratory with a view of being Assis ants later on if they prove satisfactory. When these four men are thorough trained, they will, it is hoped, be able to keep up with what is required of them.

3. *The Famine Foods* referred to last year and partially reported on th year before are still coming in. All told, 78 samples have been received up to da not counting duplicates or samples received in a bad condition. Of these 53 mentioned in the fifth and sixth annual reports, and the percentage of nitroge given there. But as samples are still being received and the analyses are therefore from being completed, no reference has been made to this work in Part II of t report. As suggested last year, it would in my opinion be advisable to publish t work in the form of a bulletin when completed, and associate with me for the p pose of preparing this bulletin some officer or officers well acquainted with the hab

f the people, who know as much as possible about how these famine foods are preared, and could describe the plants botanically and know their distribution in Mysore.

4. The analyses made at present give only the food value of these "famine oods." Whether they contain any substance or substances deleterious to the ealth of the people cannot, as pointed out on page 26 of the Fifth Annual Report betermined by these analyses. The presence of actual poisons, if suspected, could, of urse, be determined; but, unless suspected, would escape notice unless a systematic earch were made for poisons in all the samples, and that would be a very long and ifficult piece of work which would require my undivided attention for some coniderable period of time. Moreover such analyses would not even prove conclusively hat no poisons or injurious substances were present. This could only be effectively roven by actual feeding experiments covering a long period of time and careful nedical examination of the persons used in these experiments during the course of he experiment,—a method absolutely out of the range of practicability for this line f work.

5. As in their review of last year's report Government thought it would have een an advantage to give the names of these "famine foods" which had been eceived and partially analysed, I give herewith a list of their names.

LIST OF FAMINE FOODS.

No.	Kanarese name	Botanical name
134	Gutti Gadde	.....
135	Bendli Soppu	Erythroxylon monogynum.
136	Gyadari or Devadari Soppu	Ægle marmelos.
137	Navare Genasu	.....
138	Sal Genasu	.....
139	Karane Genasu	.....
140	Kal Genasu	.....
141	Akki Genasu	.....
142	Adavi Genasu	A species of Dioscorea.
143	Nose Gadde	.....
144	Kathalo Gadde	Agave Americana.
145	Eachalu Hannu	Phœnix sylvestrius.
146	Bettada Eachalu Hannu	Phœnix farinifera.
147	Jambu Nerale Hannu	Eugenia jambulona. Var. Obtusifolia
148	Kare Soppu	Canthium parniflorum.
149	Kesavina Gadde	Alacacia antiquorum.
150	Mara Genasu	Manihot utillisima.
152	Yele Genasu	.....
153	Honnagonne Soppu	Alternanthera sessilis.
154	Vishnukranthi	.....
156	Tangadi Huvvu	Cassia auriculata.
157	Kesavina Dantu	Alacacia antiquorum.
158	Chandramallige Gadde	Mirabils Jalapa
159	Bidaru Kalale (bamboo shoots) ...	.....
160	Vondalaga Soppu	Hydrocotyl Asiatica.
161	Kondal Genasu	.....
162	Narina Genaru	Dioxorea aculeata.
163	Seebe Gadde	.....
164	Byle Genasu	Dioscorea Species.
165	Bikki Kayi	Gardeni gummifera.
166	Makali Beru	.....
167	Goni fruits	Ficus Mysorensis.
168	Alada Hannu	Ficus Benglensis.
169	Pine apple fruits	.....
170	Gudi gudi fruits	Scutia Indica.
171	Chelvi Genasu	.....
172	Noor Genasu	.....
173	Noolina Genasu	.....
174	Kavali Genasu	.....
175	Godirasanida Gadde flour	.....

LIST OF FAMINE FOODS—*concld.*

No.	Kanarese name	Botanical name
176	Kannay leaves	.....
177	Marakesavina Gadde	.....
178	Kadu Nuggi Soppu	.....
179	Kadu Haruve Soppu	.....
180	Konari Gadde	.....
182	Tamarind seeds	.....
185	Alé Soppu	.....
186	Navali Bhatha	.....
207	Date stem	.....
208	Hedige Genasu	Species of Dioscorea.
209	Bagani Pith	Caryota urens.
211	Bella Genasu	.....
212	Kayi Genasu	.....
215	Kambha Genasu	.....
216	Anné Soppu	.....
219	Mullu Genasu	.....
222	Chesaka seeds	.....
224	Bamboo seeds	.....
226	Pundi Soppu	.....
230	Rice tour	Ficus glomerata.
231	Atti Kayi	.....
233	Byalada Kayi	.....
240	Chellé Hannu	Terminalia bellerica.
252	Taré Kayi	Randia dumetorum.
253	Bongari Kayi	Cassia Tora.
254	Chagachi Soppu	.....
265	Myari Bhatha	.....
268	Wild Ragi	.....
271	Babool seed	Nelumbium speciosum.
273	Lotus root	Dioscorea species.
277	Deva Genasu	Typa augustifolia.
318	Pillé Gadde	Sasbania grandiflora.
323	Agasé leaves	Diospyros Tupru.
349	Tupre fruits	.....
375	Nagre fruits	.....
383	Tangadi Soppu	.....
385	Sigé Soppu	.....
386	Hunise Soppu	.....

6. *Fertilizers.*—Most of the fertilizers analysed this year were collected by Mr. Benson, at that time Deputy Director of Agriculture for Madras. They were analysed with a view of gaining information which might be useful in expediting the passing of an act for controlling the sale of fertilizers. That it is highly desirable, from an agricultural standpoint, that all fertilizers should be properly labelled and a guarantee given as to their composition appears self-evident. At present some manufacturers give such a guarantee voluntarily, others do not, and instances are known where statements as to composition of the fertilizers, made without being guaranteed, were far from being correct.

7. This matter has been thoroughly discussed at the last meeting of the United Planters' Association of Southern India, to which all the larger dealers in commercial fertilizers had been invited, and which was attended by the Officiating Inspector-General of Agriculture for India and by the Imperial Agricultural Chemist. As I took an active part in that meeting which was, I believe, a very important one, I wish to refer to it here. (The report has been given in the daily press.*)

8. The only other analysis I wish to refer to here is that of Lantana ashes, because Government specially referred to that in their review on my last year's report. The sample analysed contained $13\frac{1}{4}$ per cent of water-soluble potash. They are therefore a very valuable fertilizer. When this fact becomes generally known, it ought to help in preventing the further invasion of Lantana, as it should stimulate people to burn Lantana for the sake of the ashes. The green branches and leaves contain 2 per cent of ash.

* The *Madras Mail* of 14th, 15th, 16th and 17th August 1906.

9. *II. Investigation into agricultural problems.*—This appears to me to be the most important part of the work of this Department, and at the same time one to which we have so far not been able to give the time it deserves. The inquiry into the sugar industry might be considered to come under this head, and to that a fair amount of time has been given. But much remains to be done even in it. Pot experiments have only just begun, and have already shown that potash manures must be applied with the greatest caution on soil like that in the Laboratory compound as they cause the soil to cake badly. The study of the conditions under which bone meal is most readily available are of utmost importance for a country having soils so rich in iron and so poor in lime and phosphoric acid as those in Mysore, especially if there is a fairly large supply of bones to be had for the collecting. The whole problem of the manuring of soils and the peculiarities of the crops generally grown in the State require to be studied in the Pot-culture house and afterwards on the Experimental Farm as far as circumstances will permit. Some plants require particularly one kind of plant food, others have difficulties in securing the required quantity of some other plant food. At least this has been found to be the case with crops grown in Europe and America, and probably applies here.

10. *III. Experimental Farm.*—This has been reported on at some length in Part II of this report. Present indications are that it will take probably two more years before the wet lands are standardised sufficiently to begin experiments proper with paddy. In regard to the dry lands little can be said until the second crop has been reaped, thrashed and weighed. Experiments can of course be begun at an earlier date, but they would have comparatively little value for at least four or five years to come. The more thoroughly the variation in the soil and the extent of the experimental error (which invariably accompanies plot experiments) are known, the more valuable the experiments conducted afterwards become. And any impatience shown in starting the experiments is sure to be severely felt later on. The outturns from the plots treated, as far as possible, alike in every respect, varied very considerably over 100 per cent: The permanent buildings are in course of erection, but so far only the barn has been finished, and that not quite.

11. *IV. Distribution of information.*—The most important item under this head is correspondence. As might be expected, this is steadily and rapidly growing in volume. It has increased more than 55 per cent compared with last year. During the official year 1,450 letters were received and 1,486 were sent out. Although a very important part of the work of the Department, it receives rather more than its share of the time, as it occupies by far the greatest part of my time. But a part of this work will be handed over to Mr. Coleman when he arrives.

12. In addition to the correspondence a large amount of information is given verbally. Some of this verbal information will, it is hoped, lead to the erection of a small modern sugar house by one of the residents of Bangalore.

13. In response to the concluding sentence of para 5 in the Government review on the last year's report, a bulletin embodying the results obtained so far in the sugar work is in course of preparation. Regarding para 10 of that review, the Kannada translation of the Fourth Annual Report has been printed and the translations of the Fifth and Sixth Annual Reports are being revised and will be ready for the press very soon.

14. *Staff.*—Of the three students undergoing training in this Laboratory last year two have been appointed Probationary Assistant Chemists, and have helped in obtaining the results published in this report. Three other scholarships have been awarded during this year to graduates of the Madras University to enable them to prepare themselves for the position of the Assistant Chemist in this Laboratory. But shortly after being appointed one of the scholars resigned. The two remaining men are very faithful and diligent in their work and will, it is hoped, make useful assistants in the course of time.

15. An Assistant on Rs. 50 per month was appointed to help with the simpler agricultural work of the Department. He is a Lingayet and a member of a family of agriculturists, and ought to be able to do good work.

16. The remainder of the staff and establishment has remained practically unchanged.

17. Mr. Coleman who was appointed last year Mycologist and Entomologist to this Department, has been studying in the Laboratories of Dr. Erwin Smith, Plant Physiologist in the Department of Agriculture of the United States of America at Washington up to October 1905 and has since then been working in the Laboratories of Professor Koch in the Agricultural Institute of the University of Goettingen, Germany. In Washington he was studying principally the Laboratory methods employed by Dr. Smith, but devoted a portion of his time to the study of the methods employed by the workers in the Entomological Division of the Department of Agriculture there. He also made a collection of insects and bulletins and other literature bearing on his subjects.

18. In Germany Mr. Coleman has been specially engaged in the study of nitrifying bacteria of the soil.

19. *Tours.*— Several tours were made for various purposes. One to attend the Exhibition at Saklespur, another to test the sugar-cane mill imported by Mr. Krishna Iyengar, Inamdar of Ooregahalli. Several were undertaken in connection with the Exhibition in Mysore. One to attend the meeting of the South Mysore Planters' Association to help them in the discussion on the proposed Experimental Farm, and still another to Kolar to visit the Mission Farm and see what was being done there in the way of making agricultural implements. To advise in the matter of water-lifts a short tour was made to Krishnarajapuram and surrounding villages. But the most important tour was to Cawnpore and Pusa to attend the meeting of the Board of Agriculture at the latter place and see what was being done by the oldest Department of Agriculture in India at Cawnpore. A report of this meeting has been submitted with my letter No. 921 of March 6th 1906.

20. In Cawnpore is an Elementary but very practical and well managed School of Agriculture and a well established Experimental Farm. Of the crops grown there wheat has received very special attention. The sugar-cane I saw there was very inferior in appearance to that grown in our State. But what interested me more than anything else were a set of drain gauges, at that time the only ones in India. Considerable work is being done with water-lifts to raise water a few feet from a canal. Connected with the Farm is a small workshop and foundry in which water-lifts and several patterns of cheap ploughs are being made. Some apparatus for well-boring was also at this foundry. The Farm and everything connected with it shows that it has been established some considerable length of time and has gradually grown from small beginnings. The soil is alluvial and although it appears uniform to the eye varies considerably in places. I hope to see more of the work at Cawnpore next year as the Board of Agriculture meets there in February next.

21. I wish to express my thanks to all the members of the Department for their faithful and untiring work, which has often kept them at their post long after "ordinary office hours."

PART II.

22. Part I, consisting of paragraphs 1 to 21, is not published for general circulation.

EXPERIMENTAL FARM.

23 As stated on page 1 of the 6th Annual Report of this Department, 30 acres of land were acquired for the purpose of starting an Experimental Farm near Hebbal village about 5 miles from Bangalore. These lands were taken possession of in January 1905. A description of the land and its location is given in the same report, and two maps showing the original numbers of the fields (and differences in level of these fields in the wet area) are also attached to that report. On these maps the plots of the new Experimental Farm, the roads, paths, irrigation channels and drainage channels are given.

24. The wet area consists of three ranges, each having 17 plots of one-tenth of an acre. Two of these ranges are on the same level and are intended for experiments with paddy. The third range is at a higher level and is intended for experiments with sugar-cane. The remainder of the land is composed of irregular plots which are not intended for experiments at present. The entire area is surrounded by a drain to prevent percolation of water from the adjoining land, and each plot can be drained or irrigated independently of any other plot. The paddy plots are half a chain wide and two chains long and are each divided into three equal sections.

25. The dry area has four ranges of 19 plots each. Besides this there are 27 other plots; all are half a chain wide and two chains long. The remainder of the dry land comprises irregular land not suited for experiments.

26. The principle underlying all experiments is, of course, to have all the conditions which may possibly influence the growth of the crop the same, excepting the one factor experimented with. If for example one kind of phosphatic manure is to be compared with another kind of phosphatic manure, the same kind and quantity of nitrogenous and potash manures must be used, and care must be taken that a sufficient quantity of these is supplied. The cultivation must be exactly alike in all respects. It must be done if possible by the same implement, to the same depth and at the same time. The climatic conditions must be the same and favourable so that they do not form the weakest link in the chain of factors influencing plant growth. The soil must be absolutely uniform and of good mechanical condition And the seed used must not only be of the same variety but of the same size and quality and sown at equal distances apart on the same day. These are some of the details which have to be attended to if absolutely reliable results are to be obtained. This matter, which has been referred to in more detail on page 5 of the Fourth Annual Report of this Department, is a very important, but unfortunately an equally difficult one. In fact it is impossible to carry out these conditions on an experimental farm, and for that reason field experiments are never absolutely accurate and have to be repeated very often and be very carefully watched if useful results are to be arrived at. The soil is rarely if ever absolutely uniform, and the other conditions vary more or less. It is therefore utter folly to attribute to any one set of field experiments absolute accuracy. All field experiments are likely to have some error attached to them, and it is the duty of the experimentor to determine as nearly as he possibly can what the magnitude of that error is likely to be. Unfortunately, many field experiments have been started on land which has not been tested at all before the experiments were begun. The desire to get results as quickly as possible has led the experimentors to trust that the soil is uniform enough, because it appeared to be so to the eye. But without having a thorough knowledge of each individual plot before beginning the experiments the experimentor is very much in the dark later on, and is unable to intelligently interpret such results as have been obtained unless indeed he has had the very rare good fortune to hit upon a field which is fairly uniform not only in appearance but in reality. The liberal use of duplicate plots will give him some idea, when the experiments are well under way, whether the soil is fairly uniform or not. But if it does not happen to be uniform they can simply betray this fact and condemn the experiments.

27. The lands of the Experimental Farm are the most suitable which could be found within reasonable distance of Bangalore. They appeared to be practically, but not absolutely, uniform to the eye. It was therefore necessary to test them carefully and determine the extent, if any, of the differences existing in the soil. Besides this, the acquired land had been in the hands of different owners and had been treated differently, and this difference in treatment had to be eliminated by a system of uniform treatment before experiments could be begun, even if the land had naturally been uniform to begin with. A third reason for having to give the land uniform treatment for a time was to try to get rid of some of the weeds which were in the land.

28. The dry land has grown one crop of ragi, and two of the ranges of wet land have grown two crops of paddy, the third has produced one crop of paddy, and a crop of sugar-cane is growing on it now.

29. In the table following are given the weights of paddy produced on the plots of the wet area.

TABLE I.

Weight in lbs. of paddy grown on the Experimental Farm at Hebbal.

Plot	Range A	Range B		Range C	
	1905	1905	1906	1905	1906
1	337	354	434	313	233
2	303	330	421	295	284
3	346	319½	404	297½	260
4	301	279½	379	303½	252
5	306½	338	318	293½	284
6	356	349	289	303	316
7	327	334½	342	268½	252
8	289	256	258	251½	226
9	316	214	249	240	207
10	288	260	259	234	225
11	317	254	236	233	198
12	285	236	258	204	198
13	284	259	250	204	216
14	228	285	289½	201	221
15	296	244	259	207	233
16	326	221	225	215	218
17	288½	221	208	199	171
Total ..	5,194	4,854½	5,078½	4,262½	3,974
Average ..	305·53	285·56	298·72	250·72	233·77

30. The crop grown in 1906 was harvested in very wet weather, and it is possible that the grain from different plots contained different amounts of moisture. The grain will have to be re-weighed later on to get accurate results, but figures given now are probably not far from the truth and serve to illustrate that in addition to the soil other factors affecting plant growth have not been quite uniform.

31. The total crop of paddy reaped from Ranges A and B together in 1905 is 9,117 lbs., that for 1906 is 9,052½ lbs., a difference of less than ¾ per cent. The two crops may therefore be considered as identical in quantity. Still there is a considerable difference in the crops produced on some of the individual plots in the two years. The greatest difference in crop for the same plot in the two years was in plot No. 2, Range B. It gave 91 lbs. of grain more this year than last year. This is an increase of 27½ per cent on last year's crop, which is apparently due to some other factor than difference in soil. We have not yet determined what that factor is. It may be due to any one or more of a large number of factors. In both ranges the plot with the greatest variation in the crops of the two years is situated very close to the western limits of the experimental field right under the tank bund. Possibly the water-supply may not have, been as uniformly distributed as it should have been But whatever the causes are, they are probably not directly connected with the soil itself, so that, as stated above, other factors as well as the soil have varied in this set of experiments.

32. Taking the ranges by themselves, Range B gave 4·62 per cent more, and Range C 6·70 per cent less, paddy in the second year, and the average difference in the individual plots for the two seasons is 8·31 per cent in Range B, and 8·21 per cent in Range C. Out of the 34 plots 23 showed differences lower than these averages. There are only a few plots therefore in which the differences in crop of the plots which are supposed to have been treated uniformly are greater than 8½ per cent when comparing the crops of the two years. If all the plots could have been kept within this range, of experimental error the results would have been satisfactory indeed.

33. The less difference there is in the yield of crops, after making due allowance for difference in season and soil, the less the experimental error and the more reliable the results obtained after the experiments proper have been begun. The greater the differences between the various crops of the same plot, the longer of

course the preliminary experiments must be continued in order to determine as accurately as possible both the limit and the average of the experimental error.

34. By comparing the highest yield which was obtained from any of the plots with the lowest one, we have some index of the difference existing at present in the soil. And as this difference exceeds by over 200% the greatest difference existing between the returns in the two different years from any one plot, it is a strong indication that there is some considerable difference in soil. This is further confirmed by the fact that none of the plots which have given comparatively high results one year have given very low results the next year or *vice versa*. But before any definite statement as to the extent of the difference in the soil can be made, some further test crops will have to be grown.

35. The fact that these differences in the soil exist makes it more difficult to make experiments on them. But with a judicious disposition of duplicate plots this difficulty can be overcome, in a very large measure at least, provided that there is reliable information as to the relative extent of these differences. Of course it is much easier and also more satisfactory to conduct experiments on an absolutely uniform piece of land. But unfortunately such a piece of land cannot always be found even if considerable time is spent in looking for it. On the piece of land selected for the experimental farm 75 borings were made to the depth of two feet and 150 samples of soil were taken and examined to test its uniformity. A somewhat similar, though less extensive, examination was made of all other lands which presented a somewhat uniform appearance and would have been otherwise suitable. As it was impossible to get an absolutely even piece of soil, the greatest possible care will have to be taken in standardising the different plots selected for experiments.

36. *Distance of planting.*—The paddy grown on the wet area as a test crop was transplanted in the ordinary way. The distance between the plants was not measured but simply judged by the eye. Two plants were put in together. To form some idea of the error liable to be introduced in this way by not having the plants at uniform distances the stalks in a small measured area were counted in each of the sub-divisions of the plots. The way employed to do this was to take a light wooden frame $17\frac{71}{100}$ inches square inside measure, lay this on the stubble of the section of the paddy plot and cut off close to the ground all the stubble enclosed by this frame. This cut stubble was put into a labelled bag and counted afterwards. The farther the plants were planted apart the greater the number of stems produced by the one plant has been as a rule. In fact, as a general rule, any difference in the distance of planting appears to have been largely compensated for by difference in tillering. Below in table number II are given the results of this counting :—

TABLE II.

Showing the number of stalks, plants and grain grown in area $17\frac{71}{100}$ inches square.

RANGE C.

Plot No.	Number of stalks in section			Number of plants in section			Average number of stalks in sections a, b, c	Average number of plants in sections a, b, c	Grain produced, calculated, lbs.
	a	b	c	a	b				
1 ...	46	48	54	10	9	10	49·33	9·66	·1165
2 ..	66	52	58	9	7	9	58·66	8·33	·1420
3 ..	64	67	57	10	7	11	62·66	9·33	·1300
4 ...	54	57	54	12	9	11	55·00	10·66	·1260
5 ...	72	67	64	10	9	10	67·66	9·66	·1320
6 ...	49	45	60	10	9	8	51·33	9·00	·1580
7 ...	65	56	59	10	10	11	60·00	10·33	·1260
..	57	59	60	9	9	9	58·66	9·00	·1130
...	48	53	49	9	9	8	50·00	8·66	·1035
10 ...	44	58	51	10	9	8	51·00	9·00	·1125
11 ...	52	51	53	10	10	8	52·00	9·33	·0900
12 .	52	47	59	8	10	8	52·66	8·66	·0990
13 ...	51	57	61	8	9	10	56·33	9·00	·1080
14 ...	56	36	56	10	9	9	49·33	9·33	·1105
15 ...	47	47	46	9	10	8	46·66	9·00	·1065
16 ..	61	52	51	11	9	9	54·66	9·66	·1090
17 ..	45	56	43	10	10	10	48·00	10·00	·0855
Total ...	929	908	935	165	154	157	923 94	158·61	1·9770
Average	54·65	53·41	55·00	9·71	9·06	9·23	54·35	9·33	·1163

Plot 3, section (*b*), has only seven plants, but these seven plants have produced 67 stalks, while in section (*a*) ten plants have produced 64 stalks and in section (*c*) eleven plants produced only 57 stalks. In the next plot and throughout the table similar instances may be found. But plants the same distance apart do not always produce the same number of stalks. Nine plants in plot 5, section (*b*), produced 67 stalks. Other nine plants the same distance apart in the same section of the next plot produced only 45 stalks, and this reduced number of stalks cannot be accounted for by the soil in plot 6 being poorer in quality, for that plot has given a heavier crop of paddy than No. 5. Plot No. 6 also illustrates that the crop does not necessarily depend on the number of stalks produced.

37. *Dry Lands.*—All the experimental area of the dry land was ploughed twice with a Canadian plough and cultivated with a "Planet Junior Horse Hoe" before being sown with ragi on July 11th and 12th. No manure was applied. The seed was sown with a local seed drill and all subsequent cultivation was the same as ordinarily practised by the raiyats in the neighbourhood. In various places near the western boundary of the Farm (the plot numbers begin from the West) garden crops had been grown by the previous occupants of the land. These places were well marked by the stand of the ragi growing on them and the boundary lines of these plots were even more apparent in the field when the ragi was growing than appears in the table of results given below. As only one crop of ragi has been reaped thus far, no analysis of the figures obtained is possible. The plots in themselves vary very considerably. But when comparing the ranges as a whole they are very much more uniform, varying not quite 27 per cent. That is, the range giving the highest yield gave 26·9 per cent more grain than that giving the lowest yield.

TABLE III.

Returns from experimental area of dry land, weight of ragi (straw and grain) per plot of 1/10 acre.

Plot No.	Range A		Range B		Range C		Range D		Range E		Range F	
	Straw lbs.	Grain lbs.	Straw lbs.	Grain lbs.	Straw lbs.	Grain lbs.	Straw lbs.	Grain lbs.	Straw lbs.	Grain lbs.	Straw lbs.	Grain lbs.
1	760	274	280	149	294	146	755	361	579	246	355	205
2	770	248	320	198	277	172	618	252	625	262	419	218
3	632	205	259	320	327	139	581	279	520	253	331	173
4	760	323	322½	186½	270	183	435	249	518	166	422	206
5	688	362	308	188	356	184	339	174	390	262	462	226
6	561⅓	180½	342½	198½	363	185	364	199	392	253	429	226
7	269½	245½	323	181	314	185	241	130	477	193	567	231
8	309	195	364½	195½	365	192	265	167	493	184	692	248
9	309½	201½	325	202	303	207	253	172	468	245	803	241
10	308	175	357	214	330	192	270	178	437	185	741	253
11	362	189	322½	197	315½	168½	243	153	Buildings		192	116
12	405	211	316	202	320	178	247	158			232	174
13	332	252	344	188	360	148	238	183			220	151
14	347	213	295	179	332	153	236	126			232½	129½
15	357½	210½	305	185	376	163	253	162			273	133
16	Nulla		Nulla		Nulla		Nulla				327	142
17	187½	100½	201	137	109	135	232	188	191	119	356	206
18	222½	122½	271	153	181	106	242	129	283	191	272	169
19	211	159	282	152	200	146	163	177	276	141	338	187
20	193	98½	268	158	265	142	283	165	172	155	302½	201½
21	...	...	...	...	...	...	...	...	158	154	294	154
Total ...	7,985	3,965½	5,806	3,583½	5,657	3,124½	6,258	3,602	5,979	3,009	8,261	3,990
Average ...	420·26	208·71	305·58	188·61	297·74	164·45	329·37	189·58	3986 0	200·60	393·38	190·00

38. Adjoining the southern boundary of the Farm were ragi fields which were ploughed and cultivated by their owners in the ordinary way excepting that these fields received a dressing of cattle manure. During the entire growing season these crops appeared to be much poorer than those adjoining it (separated only by a wire fence) growing on the Experimental Farm. The land on the Farm had been ploughed deeper but had received no manure. To find out how far this apparent difference was a real one, the Farm Superintendent obtained permission to harvest and thrash a narrow strip along the entire southern boundary line of the Experimental Farm. The area of this strip was nearly ·73 of an acre. The grain produced on this strip was 759½lbs. and the straw 1,936½lbs. As this strip is comparable with a range of the Experimental Farm and as those ranges have given fairly uniform results, it is reasonable to suppose that if there had been another range just to the South of the Farm it would, under similar treatment, have given results comparable to the other ranges. But this outside strip has, after making allowance for the maximum difference between the ranges on the Farm, only produced half the crop per acre. This difference in crop was attributed by the villagers to the difference in ploughing and as a result there was a strong demand for ploughs like those used on the Farm. But as no ploughs had been imported for sale and the Kolar Mission, who sell a somewhat similar plough, had run out of stock, this demand could not be supplied. And as this one season's result is by no means conclusive, notwithstanding that it appeared to be so striking to the villagers, I am not at all sorry that the villagers could not have their wishes satisfied; for perhaps it may save them a disappointment later on. But it is encouraging to notice this interest taken by the villagers in a thing they expect to be a marked improvement on their own.

39. *Thrashing machine.*—A "hand thrashing machine" which had given very good satisfaction at the Experiment Station in Darmstadt, Germany, was imported and tried here with ragi. Four coolies were able to turn it, but as this was harder work than they could stand for long, a bullock power was used instead. As received, the thrashing machine broke a considerable quantity of grain, enough to affect the market price of the latter. But by substituting round teeth in the cylinder and concave for the rectangular ones originally sent with the machine the breakage was practically avoided altogether. In one of the tests some breakage appeared to have taken place. But as the thrashing was done on a stone floor and the grain removed with an iron implement, and as no breakage of any account occurred when the thrashing machine stood on an earthen floor, the breakage in the test referred to was probably done after the grain had passed through the machine. On the average three-quarters of a ton of ragi straw could be put through the machine in an hour when four pairs of bullocks were used. With the rectangular teeth the machine removed all but 2½ per cent of the grain; at least that was the quantity of grain obtained when re-thrashing the straw. The drawback to a small American thrashing machine imported by the Kolar Mission is said to be that instead of completely separating the grain a large portion of heads are torn off with the grain left in them; these have to be re-thrashed by hand. In the test here with the German machine the ear heads torn off contained 7·28 per cent of the grain. In these small machines there is no provision for separating the loose grain from the chaff and ear heads. All these are left together and have to be separated afterwards. No satisfactory test as to the amount of ragi left in the straw has been made as yet with the round teeth, but the indications are that the amount of grain left in the straw is greater than when the rectangular teeth are used. The number of ear heads torn off is also greater. But as stated before, there is practically no grain broken by the round teeth.

40. The ragi grown on the experimental plots had to be thrashed in the ordinary way with bullocks. To test if this work had been thoroughly done all the ragi straw was re-thrashed some time later by machine. On the following page, in Table IV, are given the results of this re-thrashing.

TABLE IV.

Ragi straw thrashed in the ordinary way with bullocks, re-thrashed by machine. First thrashing gave 34·75 per cent grain and 65·25 per cent straw.

No.	Weight of straw re-thrashed	Ragi thrashed from straw by machine			Weight of grain left in straw per 1,000 lbs. of crop as cut	Per cent of total grain left in straw	Weight of grain left in straw per acre
		Clean grain	Grain in ear heads torn off	Total			
	lbs.	lbs.	lbs.		lbs.	%	lbs.
1 ...	1,120	21	7	28	16·3	4·48	85
2 ...	1,120	20	8	28	16·3	4·48	85
3 ...	1,120	18½	2	20½	11·9	3·31	63
4 ...	1,120	19½	4½	24	14·0	3·87	73½
5 ..	1,089	25	5	30	18·3	5·00	95
6 ...	1,120	24	6	30	17·5	4·79	91
7 ..	1,120	24	3½	27½	16·0	4·40	83½
8 ...	1,120	22	4	26	15·2	4·19	79½
9 ...	1,120	25	4½	29½	17·2	4·72	89
10 ...	742	20	5	25	22·0	5·95	113
11 ...	1,120	20	5	25	14·5	4·00	76
12 ...	1,120	16½	4¼	20¾	12·1	3·36	64
13 ...	1,120	17½	3	20½	11·9	3·31	63
14 ...	1,120	19	4	23	13·4	3·71	70
15 ...	1,120	16½	6	22½	13·1	3·63	69
16 ..	1,120	18½	5½	24	14·0	3·87	73½
17 ...	1,120	18½	5	23½	13·7	3·79	72
18 ...	1,120	15	2½	17½	10·2	2·85	54
19 ...	1,120	19	4	23	13·4	3·71	70½
20 ...	239	7½	1	8½	22·8	6·15	117
Total ...	21,110	387	89¾	476¾	303·8	83·57	1,587½
Average ...	1055·50	19·35	4·49	23·84	15·2	4·18	79·37

Nos. 5, 10 and 20 were from the bottom of the stacks of straw, and the larger amount of grain found in them is probably due to the loose grain of the layers above having accumulated in these, a thing of common occurrence. On the whole the results are very satisfactory, showing that the grain had been thrashed well. To show that these small amounts of grain left in the straw nevertheless amount to an appreciable loss of grain per acre these amounts are given in a separate column in the table above

41. For thrashing paddy the machine appears to be well suited. At least no difficulties have been noticed up to the present. As might be expected, a much larger weight of paddy in the sheaf could be thrashed than loose ragi straw. But the amount of paddy in the sheaf thrashed this year at any one time was too small to admit of the records of time being very reliable. As far as they go they indicate that about 2 to 2½ tons could be thrashed per hour.

LABORATORY COMPOUND.

42. *Ragi.*—The little plots on which ragi has been grown the past two years were again sown with ragi. No manures were applied this year, the object being to see how soon the yields from the individual plots would become comparatively constant again. Last year the uneven nature of the plots did not permit of ascribing any of the difference found in them as due to the after effect of any of the manures applied the previous season and the figures gave practically no information that year. But this year's results give some value to the figures obtained last year even though, owing to the small area of the plots, the naturally poor condition of the soil, and the uneven nature of the soil, these figures are far from being as valuable as they otherwise would be. But these experiments are as stated in the Fifth Annual Report, page 10, only a preliminary set of experiments solely intended to help in planning future experiments and not intended to give any definite results themselves. Still,

this year's figures appear to indicate that last year there was some after-effect even from poonac and bone meal. This is especially noticeable in plot 6. On the whole the last crop was considerably less than of the previous year. This is no doubt partially due to some of the plots being manured last year while none were manured this year. But even if it were totally due to season and a correction were applied for this, there would still be a very marked decline in this year's crop of plot No. 6, so that apparently this plot has depreciated in productiveness. But as plots Nos. 3 and 14 have actually given a heavier crop this year than last year and as some others have given nearly the same results the decline in the average return cannot be solely due to season.

43. On the whole the plots appear to have become more uniform in character than they were at the beginning. There is little difference this year in the average of the crops raised on the land ploughed with the Mysore plough and that ploughed with the Canadian plough, provided only those plots which have been treated otherwise in the same way are considered. The plots dug two feet deep have, however, given a heavier crop than those simply ploughed notwithstanding that the soil, as indicated by the first experiments, appears to be a little better in plots Nos. 6 and 13 (those simply ploughed) than in plots Nos. 8 and 15 (those dug deep). But it must not be forgotten that these experiments are only intended to serve as an index for future experiments and are not intended to give in themselves results which could with safety be applied to general agricultural practice. Below are given the results of the three years' crop.

TABLE V.

Experiments with ragi in Laboratory Compound.

Plot No.	Cultivation	Manuring		Yield in grain calculated per acre		
		Nature	When applied	1903	1904	1905
2	Ploughed with Mysore plough ...	No manure ...	..	168	537	237
9	Do ..	Do ...		318	...	375
3	Do ...	Cattle manure ..	1903	431	475	700
	Do ...	Do ...	1903-04	...	850	1,050
10	Do ...	Do ...	1903	656	800	750
	Do ...	Do ...	1903-04	...	1,150	1,100
4	Ploughed with Canadian one-horse plough ...	No manure ...	...	...	712	400
11	Do ...	Do ..	...	700	...	662
5	Do ...	Cattle manure ..	1903	381	675	575
	Do ...	Do ...	1903-04	...	750	750
12	Do ..	Do ..	1903	743	1,075	800
	Do ...	Do ...	1903-04	...	2,125	1,050
6	Do ...	Poonac, bone and muriate of potash ..	1903	1,472	825	525
	Do ...	Do ...	1903-04	...	2,025	975
13	Do ...	Do ...	1903	2,062	700	675
	Do ...	Do ...	1903-04	...	2,225	1,050
7	Do ...	Double quantity poonac, bone and muriate of potash ...	1903	1,400	1,050	1,075
	Do ...	Do ...	1903-04	...	1,325	1325
14	Do ...	Do ...	1903	1,900	1,075	1,325
	Do ...	Do ...	1903-04	...	..	1,425
8	Dug 2 feet deep ...	Poonac, bone and muriate of potash same quantity as in plots 6 and 13 ...	1903	1,371	975	1,300
	Do ...	Do ..	1903-04	...	1,800	1,325
15	Do ...	Do ...	1903	1,362	1,450	1,175
	Do ...	Do ...	1903-04	...	1,150	1,350
	Average ...	Do ...	...	...	1,131	896

44. *Ground-nuts.*—The ground-nuts were quite as badly diseased this year as last year. The treatment of the seed with one per cent solution of copper sulphate appears to have had a slightly beneficial action. Below is given the yield given by the treated and the untreated seed calculated per acre. But as this is only the result from one year's test, the experiments must be repeated before they can carry weight.

TABLE VI.

Yield of ground-nuts from seed treated with copper sulphate compared with that from untreated seed.

Variety	Yield calculated per acre in pounds			
	1903	1904	1905	
			reated	Untreated
Virginia	10,100	3,550	2,810	2,386
Japanese	8,950	4,100	2,945	2,103
Pondicherry	6,925	4,550	1,996	1,864

45. *Caravonica cottons.*—Nos. 1 and 2 have been grown in the compound in a small plot, and judging by present appearances they may possibly give very fair returns. They were, however, irrigated whenever the soil got dry and received throughout the best of treatment.

SUGAR-CANE.

46. A small patch of sugar-cane was grown on "new" ground to supply material for making tests in milling, to study the deterioration of the cane after cutting and such other factors as last year's experiments had suggested. The plants germinated very poorly, many of the sets being eaten by white ants, and others were injured; and later on, many of the canes were attacked by the borer, some very badly. The cane when ripe for cutting varied so much that it was impossible to select small samples sufficiently uniform to test the depreciation of cane after being cut. Two attempts were made to get uniform samples for this work, but both failed. The cane was used to make some of the milling tests given below; and an experiment is in progress to test the injury done to the quality of sugar-cane by borers.

47. *Extraction.*—This year the percentage of juice extracted from sugar-cane by four different mills was tested; two of these were bullock mills, one, a locally-made one with rollers $6\frac{3}{4}$ inches in diameter, the other from Northern India with the two main rollers $8\frac{1}{2}$ inches in diameter and the feed roller 7 inches in diameter. The other two were a larger mill imported from Scotland driven by a $6\frac{1}{2}$ horse-power oil engine with rollers 12 inches in diameter and a small American hand sugar-cane mill in which the rollers were 5 inches in diameter. All these mills have three rollers and were set as tight as circumstances permitted. The results are given in Table VII on page 52.

TABLE VII.

Extraction.

Mill	How set	Power required to drive	Cane milled per hour, lbs.	Extraction calculated on weight of begasse	Mark in cane	Per cent of juice left in begasse	Loss of sugar per acre taking 20 tons of cane are grown per acre lbs.	Per cent of lucrose in juice
(1) Local bullock power cane mill. Average of 30 experiments.	Tight	Same as No. 8	...	67·4	8·77	26·10	1,919	18·0
(2) Power mill	Tight	6½ H. P.	...	75·98	8·10	17·33	1,276	1·79
(3)	...	...	1,852	77·76	7·26	18·31	1,905	1·44
(4)	...	...	1,971	74·24	8·54	18·83	1,118	14·5
(5)	..	...	1,911	...	7·97	18·16	1,163	15·6
(6) Hand mills. Average, first crushing.	...	Easily turned by one cooly	115	66·3	7·95	28·74	1,931	16·3
(7) Hand mill. Cane passed through twice.	...	...	...	75·14	7·95	18·37	1,234	16·3
(8) Local bullock mill. Three canes at a time.	...	Average about 105 lbs.	222	66·5	8·00	27·70	1,918	16·8
(9) Nahan bullock mill. Three canes at a time.	...	Average about 165 lbs.	325	69·1	8·00	24·90	1,724	16·8
(10) Nahan bullock mill. Four canes at a time.	...	Average about 205 lbs.	400	68·2	8·00	26·00	1,800	16·8

Both the cattle mills had vertical rollers; the other two horizontal rollers. The hand-power mill crushes about 115 lbs. of cane per hour and is only intended for crushing samples for analysis. It is included in this list because it is the only mill through which the cane has been passed a second time. The first crushing with the hand sugar-cane mill left very nearly the same amount of sugar in the refuse as the local cattle mill had done. But by passing this refuse through the mill again fully one-third of the juice left in that refuse was removed. Taking that 20 tons of that particular kind of cane had grown per acre this would have saved about 700 lbs. of sugar per acre, or in round numbers nearly 40 maunds of jaggory per acre. If the cane has been as well milled as it was with the cattle mill here, the refuse is so torn up that it cannot be fed through a vertical mill a second time. It is only a horizontal mill fed by a cane carrier which would make such a course practicable.

48. The power mills saved on an average, compared with the cattle mill, 756 lbs. of sugar per acre, again assuming that the crop is 20 tons of cane per acre. This made a difference of about Rs. 50 per acre, taking into account simply the better extraction this will give. But besides this, the difference in the expense of running a mill by bullock power and by an oil engine will have to be considered.

49. The average of a few tests comparing the local mill with that from Northern India showed that the imported mill crushed considerably more cane per hour when both were fed with three canes at the time. This is principally

due to the larger rollers, but possibly it may also be partly due to the fact that the feed roller had deep grooves running lengthwise and this made the mill grip the cane more securely and prevented loss of time in feeding. The extraction was also somewhat greater, which gave a saving of something between 100 and 200 lbs. of sugar, or about 8 maunds of jaggory per acre. The draft, which was nearly half as much again as that required for the local mill, is almost completely compensated for by the more rapid milling. In the local mill it was difficult to mill four canes at the time, but in the imported mill this could be done easily. It is rather surprising that milling of cane with the local mill is considered rather hard work for bullocks, especially when only two canes are being fed at the time and the rollers are not set as close as they were in these tests; for with two canes the average draft required in the tests here was only about 65 lbs. The Nahan Mill cost Rs. 161 landed here; of this Rs. 59 was freight

50. *Composition of begasse.*—As a general rule the begasse (the refuse cane left after milling) is used as fuel in sugar boiling. To form some idea of its manurial value a number of samples of air-dried begasses were analysed to determine its manurial value. Below in Table VIII are given the results of these analyses.

TABLE VIII.

Composition of begasse (refuse cane) after being dried in air.

Number	Nitrogen	Lime	Potash	Phosphoric acid	Moisture
412	0·24	0·101	0·31	0·166	6·57
424	0·34	0·103	0·30	0·160	7·29
428	0 23	0·100	0·19	0·130	7·76
431	0·16	0·085	0·185	0·120	6·47
441	0·24	0·140	0·23	0·130	..
451	0·23	0·120	0·28	0·145	.
Average ...	0·24	0·108	0·246	0·142	.
Per acre (Begasse representing 20 tons of cane) ...	lbs. 11·41	lbs. 5·13	lbs. 11·69	lbs. 6·75	...

It will be seen from the above table that the manurial value of the begasse is very little indeed. At current market prices fertilizers containing the same amount of plant food as is contained in the begasse obtained from an acre of cane (calculating that an acre produces 20 tons of cane) could be bought for Rs. 8 per acre. Incidentally these analyses of begasse give us some indication of the amount of plant food removed per acre, for probably a large portion of plant food actually removed is contained in the begasse. Analyses of the juice and the leaves and tops will be made next year. But, unless these substances contain much larger quantities of plant food than is expected, sugar-cane will probably form a striking illustration of the fact that the manurial requirements of a plant cannot be gauged by the amount of plant food stored up in its tissues.

51. *Pot-cultures and a study of the soil used for the same.*—As a large part of the pot-culture house was put up by the servants of the Department, who could only work at it when other work was not too pressing, the house was not ready for working in until the close of the official year. A set of experiments has been begun to study the factors which affect the availability of bone meal. On one of the Mysore coffee estates on which milled bone was applied in pits more than 28 years ago it still remains and is occasionally being dug up. On another estate in Coorg, where bone meal is applied on the surface and is in the course of a short time covered by leaves, the bone disappears in a very short time and little of it can be found ten months after it has been applied. In both cases the meal was not fine and contained pieces an inch or more in length. A *possible* cause for this

difference is that either the micro-organisms which cause the decomposition of the leaves into mould may help in the decomposition of the bone, or that the carbonic acid produced by the decomposing vegetable matter may have helped to dissolve the bones. To see if the organic matter had anything to do with the decomposition of the bone and to test the availability of bone meal under tropical conditions a set of pot-culture experiments has been started. In these bone meal of two different grades of fineness has been applied in different ways, (*a*) mixed with the top two inches of soil, (*b*) mixed with the top two inches of soil and covered with vegetable matter, and (*c*) applied on the surface and covered with vegetable matter. The ordinary precautions were taken to have pots in which the soil was unmanured and some in which only nitrogen and potash had been supplied. Provision to study the effect of the mulch of organic matter applied on the surface of the pots was also made. The crop used is ragi.

52. Before beginning these experiments it was necessary to study the soil intended to be used in them, to find out how closely it ought to be packed in the pots and what percentage of water in the soil was likely to give satisfactory results. For it is not only sufficient in pot experiments to have the same kind of soil in all the pots but to have it compressed uniformly and to have the same percentage of water present in each pot. The water-holding power of the soil used is 31·4 % and its specific gravity at 32° C is 2·677. Soil containing 10 % of water appeared, when handling it, to have about the right amount of moisture for the growth of ragi. To get some further insight into the quantity of water which it would probably be found necessary to add to the soil used for these experiments, a glass cylinder 16 inches long was filled with this soil as tightly as it was thought necessary to pack the soil in the pots and sufficient water was added to make the total moisture of the soil in this cylinder up to 10 %. This cylinder was open at the top and bottom, but to prevent evaporation was covered with a glass plate. The cylinder with the soil and water was weighed just after the water had been poured on, and to make sure no water had been lost by evaporation, was again weighed just before the experiments were completed. The following figures show the rapidity with which the water entered the soil.

Number of hours after adding water	The water had penetrated
3	8¼ inches.
20	10¼ ,,
48	10⅞ ,,
96	11¼ ,,
120	11½ ,,

After standing five days it was very difficult to detect by the difference in colour of the soil the depth to which the water had penetrated. But apparently it sank no further than 11½ inches. The following table shows the percentage of moisture of the soil in the cylinder at the various depths a week after the water had been added.

TABLE IX.

Showing percentage of water at various depths.

1st	inch ...	13·54	per cent of water	9th	inch ...	10·71	per cent of water
2nd	,, ...	1[illegible]·13	,,	10th	,, ...	9·91	,,
3rd	,, ...	12·41	,,	11th	,, ...	8·95	,,
4th	,, ...	12·28	,,	12th	,, ...	5·62	,,
5th	,, ...	12·70	,,	13h to bottom of cylinder	,, ...	1·49	,,
6th	,, ...	12·41	,,				
7th	,, ...	11·84	,,				
8th	,, ...	11·58	,,				

In taking the samples out of the cylinders and in weighing, nearly ¾ % of the moisture was lost, the total moisture being, instead of 10 %, only 9·3 % on the average. From this it is evident that if only water sufficient to give the soil 10 % of water is added, the bottom layers of soil will not get the water they require; and as in nature the water is supplied from the surface, it was considered necessary to supply enough water to the pots to reach the bottom layers of soil. For this purpose 12 % of water was necessary for this particular soil.

53. To form some idea of the extents to which the soil ought to be compressed samples were taken from a plot of ground in the Laboratory compound on which ground-nuts were growing and which had been ploughed about two months before. Below are given the space actually occupied by the soil particles and the moisture of the samples at various depths down to 5½ feet:—

TABLE X.

Depth at which sample was taken	Space occupied by soil particles. %	Moisture. %
Surface to 6″	62·53	5.37
6″ ,, 1′	53·17	9·03
1′ ,, 1′-3″	66·95	9·64
1′-3″ ,, 1′-6″	65·14	10·32
1′-6″ ,, 1′-9″	66·43	10·47
1′-9″ ,, 2′	65·97	10·67
2′-3″ ,, 2′-6″	63·88	10·62
2′-6″ ,, 2′-9″	65·13	11·08
2′-9″ ,, 3′	64·50	11·64
3′ ,, 3′-3″	65·23	11·50
3′-3″ ,, 3′-6″	63·78	11·55
3′-6″ ,, 3′-9″	60·60	11·37
3′-9″ ,, 4′	62·53	11·65
4′ ,, 4′-3″ ...	63·39	11·80
4′-3″ ,, 4′-6″	64·28	11·64
4′-6″ ,, 4′-9″	66 83	11·71
4′-9″ ,, 5′	63·52	10·73
5′ ,, 5′-3″	62·66	11·33
5′-3″ ,, 5′-6″ ...	61·31	12·02
Average below 1 foot ...	64·24	11·16

Apparently the top 6 inches of soil had become almost as compact again a the subsoil; but the next 6 inches were much softer than the top (the soil ha been dug about 1 foot deep) and these second 6 inches of soil were taken a the standard to which to compress the soil in the pots. Other tests had als shown that soil compressed to such an extent (that the soil particles actual occupied 53 % of the space) would be about as compact as a field would be aft it had been ploughed for a short time. The reason for giving the above table in fu is to show the gradual and almost constant increase in the percentage of wat from the surface down. These samples were taken in the hot weather, and the resul appear to indicate, when taken in conjunction with Table IX, page 16, that th soil tends to retain 12 or 13 % of water under ordinary circumstances. Some oth tests made in regard to the capillarity of the soil in question will be reported some later date.

54. *Fertilizers.*—At the suggestion of the Department of Agriculture Madras the matter of the standardisation of fertilizers was brought up at the meeting of the Board of Agriculture at Pusa, but a full discussion of that was deferred for a year. To obtain further information about the fertilizers for sale in Southern India an attempt was made to collect and analyse samples all fertilizers on the market in Southern India Mr. Benson, the then Dep Director of Agriculture of Madras, undertook the collection of the samples a

forwarded them to the Laboratory of this Department for analysis. In all 47 mixed or "patent" fertilizers and 86 samples of ordinary fertilizers (such as oil cakes, bone meals, sulphate of potash) were received. Mixed fertilizers are no doubt those which lend themselves most easily to fraudulent practices, and are those in which a guarantee as to quality is most urgently required. But this particular set of samples was supplied directly by a large and well-known firm, so that adulteration was out of the question, and as neither the price of the fertilizer nor any guarantee as to their composition accompanied these samples it would have been impossible to detect adulteration if it had been practised. Probably the price charged for these fertilizers and a guarantee as to their composition could have been obtained. But as there was not sufficient time to undertake all the analyses, the mixed samples were not analysed this year.

55. In Tables XI to XV, on pages 57 and 65, are given the results of the analyses of these fertilizers for the sake of comparison, the averages, maxima and minima, of the most important of the fertilizers analysed in previous years are also given.

Results of analyses of oil cakes and dried blood.

No.	Substance	Results of previous year's nitrogen			Results of 1905-06.						Price per ton	Value per unit of nitrogen making no allowance for potash or phosphoric acid
		Average	Maximum	Minimum	Nitrogen	Loss on ignition after drying	Phosphoric acid	Potash	Insoluble residue	Source		
	2	3	4	5	6	7	8	9	10	11	12	13
											Rs. a. p.	Rs. a. p.
	White Castor	6·37	8·69	4·53	...	...	...	...	...	...	.....	.....
	Do	...	...	...	4·25	...	...	...	..	Madras West Coast.	60 0 0	14 1 1
	Do	...	...	...	4·95	.	...	...	...	Do ..	60 0 0	12 1 11
	Do	..	..	...	5·26	86·99	1·88	0·96	2·82	East ...	72 0 0	13 11 0
	Do	...	...	...	5·46	...	...	...	...	Madras ...	77 8 0	14 3 1
	Do	...	..	...	6·22	...		..	...	Mysore ...	66 0 0	10 15 2
	Do	..	..	...	6·23	...	...	...	...	Do ...	57 8 0	9 2 5
	Black Castor	...	...	...	3·99	...	1·86	...	10·64	Do ...	.....	.....
	Do	...	...	..	4·22	...	...	...	...	Do ...	48 0 0	11 6 0
	Do	...	...	...	4·33	...	...	...	...	Do ...	50 0 0	11 8 9
	Do	...	..	...	4·64	...	...	...	..	Madras West Coast	57 8 0	12 6 3
	Do	..	...	...	4·74	..	...	...	...	Do ...	50 0 0	10 8 9
	Do	...	...	..	4·78	...	..	..	...	Madras ..	57 8 0	12 0 6
	Do	...	...	..	4·89	...	...	...	...	Do ...	65 0 0	13 4 8
	Hongay (Pongamia glabra) ...	3·83	·01	3·59	...	...	...	...	..	...	.....	.....
	Do	...	...	..	3·37	...	...	...	..	Madras West Coast...	47 8 0	14 1 6
	Do	...	...	...	3·92	...	...	...	..	Mysore ...	40 0 0	10 3 3
	Do	...	...	...	4·03	88·04	0·88	..	1·52	Madras ...	57 8 0	14 4 3
	Do	...	...	...	4·05	85·91	1·50	1·06	2·95	East Coast ...	50 0 0	12 5 6
	Do	...	...	...	4·05	...	...	...	...	Mysore ...	40 0 0	9 15 10
	Do	...	..	...	4·11	...	...	...	...	Do ...	45 0 0	10 15 2
	Neem (Melia Azadirachta) ...	4·86	4·12	5·99	...	...	...	..	...	.....	.....	.....
	Do	..	...	...	3·89	83·20	0·92	...	4·98	Madras ..	62 8 0	16 1 1
	Do	...	...	..	5·11	..	..	..	...	Mysore ...	45 0 0	8 12 10
	Do	...	...	...	5·38	82·08	1·92	...	5·34	Madras East Coast ...	50 0 0	9 4 8
	Ippe (Bassia latifolia)	2·97	4·14	1·80	...	...	..	...	...	.....	.....	.....
	Kurdi (Carthamus tinctorius)	5·70	3·22	8·30	...	...	...	...	..	.....	.....	.....
	Do ...	...	...	...	2·58	94·98	1·37	0·80	1·39	Madras ...	.....	.....
	Ground-nut	...	...	...	7·89	88·33	1·60	1·20	1·77	Do East Coast ...	70 0 0	8 13 11
	Til ..	...	..	...	4·93	..	...	...	...	.....	.....	.....
	Dried Blood	...	11·55	10·40	...	...	...	.	...	.....	.....	.....
	Do	..	...	...	11·51	81·48	0·42	[illegible]	5·81	Madras	115 9 0	10 0 0

56. This year's analyses of oil cakes again exemplify the fact that there is a very considerable difference in the quality of oil cakes.

57. *White Castor* varies from 4·25% nitrogen content, to 6·23%. None of these appear to be free from adulteration, but the general principle that they vary with the district from which they come, again holds good, the West Coast of Madras having white castor decidedly poorer in quality than Mysore.

58. *Black Castor* has this year a fairly uniform composition, the maximum being only about 15% above the minimum in quality.

59. *In Hongay and Neem* the variations are a little greater than they have been heretofore, the minima being lower and the maxima being higher than have been noticed before, in Neem there being a difference of a little over 38% between the poonac of best and poorest quality. But in neither of these is the variation anything like as great as in White Castor, Ippe and Kurdi. In these three the difference in quality, found up to date, is over 100%, and is principally due to difference in variety, but partly to adulteration.

60. Special attention is called to the last column in the above table, which gives the price per *unit of nitrogen* charged for each of the fertilizers. The price per unit of nitrogen is obtained by dividing the price of the fertilizer per ton by the figure representing the percentage of nitrogen. If the fertilizer contains small quantities of plant food other than nitrogen, the value of these should be deducted from the price of the fertilizer before dividing it by the figure representing the percentage of nitrogen. All oil cakes contain a small percentage of both phosphoric acid and potash. But the value of these is so small compared with the nitrogen contained in oil cakes that these substances (potash and phosphoric acid) are not always determined, and the entire cost of the oil cake is debited to the nitrogen contained in it. Sometimes the amount of phosphoric acid which, as will be noted, varies in the above table from 0·88% to 1·92% is determined, and if allowance is to be made for this we may consider this phosphoric acid to be worth about Rs. 3 per unit. To determine the unit value of nitrogen in oil cakes when allowing for the phosphoric acid, multiply the figure representing the percentage of phosphoric acid by three and deduct the result from the price in rupees of the oil cake in question and then divide the remainder by the figure representing the percentage of nitrogen. Of course the organic matter in the oil cakes is as such of some value provided it does not contain too much fat, but this does not possess a commercial value.

61. By comparing the figures in column 13 of the above table it will be noticed that sample No. 298 is nearly twice as expensive per unit of nitrogen as sample No. 285, and an average sample of safflower cake at Rs. 45 per ton (the price at which it is quoted now) would be cheaper still (being about Rs. 8 per unit).

62. *Milled fish.*—The results of this year's analyses reduce the already very low minimum of nitrogen found in milled fish in previous years. Sample No. 77z was offered to a West Coast firm on a guarantee, but as it did not come up to that guarantee it was declined. All the samples analysed this year contain an excessively large proportion of sand. The average of the insoluble matter found in the samples analysed some years ago was a little less than 6%. This year's average amounts to more than six times this quantity (39·56). Such excessive adulteration reduces very materially the value of milled fish as a manure.

63. As will be seen by comparing the results given in the table (p. 59) a marked variation again exists in the composition of the samples of milled fish both in their nitrogen content and in the phosphoric acid, and, although this difference is not as marked as it has been in previous years, it is very considerable. There is also a very striking difference in the cost per unit of both nitrogen and phosphoric acid as given in columns 18 and 19 in the table on page 21. To determine the cost of the units of nitrogen and phosphoric acid in these manures it has been assumed that a pound of nitrogen is four times as valuable as a pound of phosphoric acid.

72. *Potash fertilizers.*—Among these should be included ashes and *saltpeter*. The latter are therefore again included in this table although they have already been given in Table XIII. In column 10 in Table XV, page 65, is given the cost price of a unit of potash in saltpeters on the assumption that they are bought simply for the sake of the potash contained in them. The figures given there show that even if the nitrogen is disregarded, the potash is no more expensive than in the form of muriate or sulphate of potash.

73. *Kainites.*—In these the unit of potash is very expensive, running up to Rs. 5-13-5 per unit, a price more than 50 % above that at which potash could be bought in other fertilizers. But even at that high figure there is little profit in it for the firm which imported that particular shipment on account of the very limited sales they have had. But it is absolutely useless to import Kainite or any other fertilizer if after it arrives such a prohibitive price has to be charged for it that it would be foolish for any one to buy it.

74. *Sulphate of potash.*—Included under this head is a fertilizer just placed on the market called "Stane's Sulphate of Potash." It is sold at a price decidedly lower than the imported sulphate, and if the supply is constant and the quality and price remain in the same relation with the imported fertilizer as they stand now, there ought to be a good demand for this fertilizer in time. Samples No. 75 and No. 79 are fertilizers having a decidedly acid reaction, and cannot therefore be recommended on soils as poor in lime as those of Mysore until after they have been thoroughly tested and found to have no injurious results.

75. *Ashes.*—In last year's report, page 48, reference was made to *Lantana ash*, and in their review of last year's report Government directed that a sample of Lantana ash be analysed. The sample of Lantana ash was prepared some years ago from Lantana growing in this compound. As stated in the Table XV, page 65, it contained 13·26 % of water soluble potash. The total potash soluble in acids was 15·74 % and the phosphoric acid 4·50 %. This sample of ash contains therefore about the same quantity of water, soluble potash as Kainite, one sample of which is quoted at Rs. 80 per ton. But, as pointed out above, the price of potash in Kainite is very high. But at the ordinary market price of potash, this sample of Lantana ash would still be worth Rs. 46 per ton for the potash it contains. The phosphoric acid would be worth a little over Rs. 13, making the total value of the ash nearly Rs. 60. Unfortunately the green Lantana stem, branches and leaves contain only about 2 % of ash. But, notwithstanding this, the high value as a fertilizer these ashes possess ought to help very materially in keeping down Lantana in districts where there is a demand for a potash fertilizer. *Paddy husk ashes* are generally considered to be of very little value. But they are by no means the poorest sample of ashes analysed in this Laboratory, as they contain 1·57 % of water-soluble potash. And the fact that paddy husks contain a high percentage of ash (those analysed here contained 21·6 %) should make them comparatively plentiful where paddy husks are used as fuel. In Table XI on page 49 of last year's report are given a number of analyses of wood ashes which show the great variations which exist in their composition. From that table the composition of Bratty ashes and bamboo ashes have been borrowed for Table No. XV given below. The maximum and minimum amounts of water-soluble potash found in mixed wood ashes analysed in former years in this Laboratory have also been included.

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TABLE XV.

Showing composition of potash Fertilizers.

No.	Substance	Water	Insoluble residue	Potash water-soluble		Chlorine	Received from	Price	Cost per unit of potash	
				Found	Guaranteed				Considering potash only	After deducting nitrogen
1	2	3	4	5	6	7	8	9	10	11
		%	%	%	%	%		Rs.	Rs. a. p.	Rs. a. p.
75	Double sulphate of potash and soda	0·12	1·48	31·52	...	0·16	Madras	...	.....	.....
79	Do	...	2·30	32·38	..	0·88	Do	...	.....	.....
246	Do	..	..	..	...	...	Do	...	.....	.....
83	Stane's sulphate of potash ...	..	8·23	45·13	40·00	...	Do	..	.....	.....
282	Sulphate of potash	0·10	0·45	51·33	...	...	Madras East Cost	120	2 10 6	.....
290	Do	..	...	...	51·	...	Madras	197½	3 13 5	.....
313	Do	...	...	44·06	..	..	Do	250	.....	...
352	Do	0·19	0 77	46·58	48·60	...	Bombay	235	5 5 4	.....
281	Muriate of potash	0·18	0·30	53·82	...	48·37	Madras East Cost	...	.....	.....
315	Do	...	...	58·63	..	48·03	Madras	168¾	3 2 2	.....
	Do	...	...	..	51·40	..	Mysore	210	3 9 4	.....
351	Do	...	...	54·80	50·50	48·57	Bombay	260	.....	.....
280	Kainite	1·28	114	12·25	..	...	Madras East Cost	..	.....	.....
339	Do	0·32	0·88	13·70	...	17·20	Mysore	7½	5 14 8	.....
350	Do	2·67	1·09	13·35	12·40	...	Bombay	80	5 13 5	.....
294	Saltpeter	0·60	0·23	40·45	..	...	Madras	...	.....	.....
295	Do	1·25	0·42	26·88	...	...	Do	205	5 1 1	2 9 0
337	Do	0·46	0·44	35·78	...	...	Mysore ...	105	3 14 6	1 15 8
	Mixed wood ashes, maximum of former analyses ..	...	...	2·32	..	...	.....	125	3 7 11	1 12 0
	Mixed wood ashes Minimum of former analyses ...	..	...	0·40	..	..	...	...	.....	.....
250	Lantana ashes	..	...	13·26		..	Mysore	...	.....	.....
	Paddy husks	..	..	1·57	...	..	Do	...	.....	.....
	Bamboo ashes	...	..	5·40	..	..	Coorg	..	.....	.....
	Bratty ,, ...	...	...	2·53	..	..	Mysore	...	.....	.....

INSECT PESTS AND PLANT DISEASES.

There have been numerous inquiries regarding remedies for insect pests and plant diseases. Borers of various kinds have been as numerous as ever, and the sugar-cane borers have been more numerous than I have seen them before. The boll worm and "red bug" have been noticed very much, the latter especially, on Caravonica cotton. An Epilachne has been reported as especially injurious to potatoes. The caterpillar of a moth (Ophinsa melicerte) has been reported from various districts as affecting castor very badly, and the Kumbli Hula has been particularly destructive in a few places. But until Mr. Coleman arrives, there is no chance of dealing with these and a large number of other pests in anything but a superficial way. But it is hoped that Mr. Coleman will be ready to join his appointment of Mycologist and Entomologist early in 1907.

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